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**Sustainable Development and Exhaustible
Resources:
The Case of Bauxite Mining in Vietnam**

Hoa Hoang

**Capstone Report Series 2009-2010
Department of Economics**

RAJ SOIN
College of Business
WRIGHT STATE
UNIVERSITY

**SUSTAINABLE DEVELOPMENT AND EXHAUSTIBLE
RESOURCES: THE CASE OF BAUXITE MINING IN VIETNAM**

A capstone project submitted in partial fulfillment of
the requirements for the degree of
Master of Science

By

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I HEREBY RECOMMEND THAT THE CAPSTONE PROJECT PREPARED UNDER MY SUPERVISION BY Hoa Thi Khanh Hoang ENTITLED Sustainable Development and Exhaustible Resources: The Case of Bauxite Mining in Vietnam BE ACCEPTED IN PARTIAL FULLFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF Master of Science.



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ABSTRACT

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Sustainable Development and Exhaustible Resources: The Case of Bauxite Mining in Vietnam

In 2007, the Vietnamese government declared an ambitious master plan to extract its bauxite resources, mainly concentrated in the Central Highlands. The impact of bauxite mining on the livelihoods of indigenous people and the macroeconomy have been debated by many scientists, economists, environmentalists, and journalists, both in Vietnam and among the Vietnamese who live overseas. From a holistic perspective to sustainable development, this paper analyzes the potential impacts of the Tan Rai and Nhan Co bauxite mining and alumina refining projects, the major part of the Vietnamese government's master plan. At a macroeconomic level, the possible occurrence of the "resource curse" and the Dutch disease also are examined. The final conclusion is that the extraction of bauxite resources will adversely affect the economy, environment, and society of the Central Highlands as well as the stabilization of the national economy. This paper may provide an insight into the projection of bauxite mining and contribute to the success of the regional and national sustainable development policies.

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I. INTRODUCTION

Conventional wisdom holds that natural resources usually are extracted in mineral-rich countries in the early stages of economic development. In the past, nonproduced resources such as oil, coal, and bauxite were the major exports and sources of growth for many countries during the period of industrialization. For example, in 1913, the United States was the world's largest exporter of natural gas, petroleum, copper, coal, and many other minerals. Particularly, U.S bauxite exports accounted for 37% of the world total (Wright, 1990, pg. 661). In recent decades, bauxite-rich countries such as Guinea, Brazil, Jamaica, and China aggressively have extracted this natural endowment to export or to develop the aluminium (i.e aluminum) industry. Bauxite mining activities are brought into question by many researchers and policy makers due to substantial and prolonged impacts on the national economy and the livelihoods of indigenous people.

Since the 1970s, the notion of sustainable development has captured the attention of economists and become a catchword of environmentalism and international finance (Daly, 1996). Although the disagreement on a clear-cut definition of sustainable development has not been resolved, a consensus holds that sustainable development is comprised of at least three parts: economic, environmental, and social. Given the intertwinement of these constituent parts, if social or environmental impacts are ignored in a country's economic development process, then that country is unlikely to sustain a steady growth. Experiences from mineral-rich countries have shown that the excessive extraction of natural resources can have unexpected trade-offs such as ecological

destruction (i.e. social, environmental and cultural degradation) and may impede economic development.

According to the Mineral Commodity Summaries provided by the United States Geological Survey (USGS) in 2009, Vietnam holds 5.4 billion tons of bauxite reserve base¹, which accounts for 14.2% of the world's reserve, and ranks third after Guinea and Australia. In particular, the Central Highlands account for 90% of Vietnam's bauxite reserve base, of which 3.4 billion tons are in Dak Nong province, which accounts for 63%, and 975 million tons in Lam Dong province, which accounts for 18% of Vietnam's bauxite reserve base.

The Vietnamese government has recently declared an ambitious plan to extract its bauxite resources and start a large-scale alumina production in the Central Highlands. In 2007, it signed a strategic agreement with the Chinese government to extract bauxite resources in the Central Highlands. Along with Vietnam National Coal and Mineral Industries (Vinacomin), Chalieco, a subsidiary of the Aluminium Corporation of China Limited (Chalco), the world's third-largest aluminium producer, has become the primary investor in bauxite mining projects. A bauxite-aluminium complex in Tan Rai commune, Lam Dong province started construction in July, 2008 and the second bauxite project will occur in Nhan Co commune, Dak Nong province, in late 2009. In June, 2009, the Deputy Minister Nguyen Sinh Hung claimed that the Vietnamese government's plan to develop bauxite, alumina, and aluminium industries would contribute to the socio-economic

¹ Bauxite reserve base is considered as "economically extractable". Definitions of reserve base and reserves are provided in the Appendix C of the USGS Mineral Commodity Summaries, retrieved November 30, 2009, from <http://minerals.usgs.gov/minerals/pubs/mcs/2005/mcsapp05.pdf>

development of the country in general and the Central Highlands in particular, both in the short run and long run (as cited in Hoang, 2009).

This decision, which holds many political implications, could potentially have enormous social and environmental impacts. As a result, it has sparked a public outcry from scientists, economists, environmentalists, the media, and many other groups, both in Vietnam and among the Vietnamese who live overseas. Scholars, experts, and people who oppose the government's decision have created a website *www.bauxitevietnam.info*, updated daily with articles, public opinions, and multi-sided analyses pertaining to bauxite mining activities. Almost nine million people have visited this website and 2,300 people living in Vietnam and abroad have signed three petitions calling on the government to terminate the bauxite projects. Moreover, the national hero, General Vo Nguyen Giap, who is well-known for his excellent leadership in the Vietnam War, also wrote three letters to the Prime Minister and the Politburo. Since the Central Highlands was a strategic region in the war and is also renowned for cultural and natural diversity, he emphasizes that the environmental, social, and cultural impacts on the Central Highlands will be unavoidable and immense once these projects come into operation. Furthermore, he claims that the development and sustainability of the Central Highlands will be impaired and the national security will be threatened (Giap V. N., letter, 2009, para. 4)².

Bauxite is the raw material from which alumina is extracted (see Appendix for further details). The production of alumina from bauxite, divided into two main phases

² The copy of his letter sent to the Politburo, the National Assembly, and the Government regarding the bauxite mining projects in the Central Highlands is retrieved on November 11, 2009, from <http://bauxitevietnam.info/c/1933.html>

including bauxite mining and alumina refining, has many effects that are potentially harmful to the physical and natural environment and socio-economic system (Acero, 1998). Bauxite mining presents ecological challenges such as deforestation, resettlement of the local people, hydrologic disturbance, air and water pollution, and the untreated red mud and tailing slurry from ore sifting.

The impacts of these bauxite mining projects are diversely discussed. On the one hand, the Vietnamese government believes that the development of bauxite and alumina industry could generate more benefits than costs even when the environmental impacts are evaluated. On the other hand, to many experts, little is known about how we can assess development impacts because environmental, social, and cultural impacts are qualitative rather than quantitative. At the local level, mining bauxite ores in the region not only creates few jobs for the local economy but also potentially impedes agricultural production, which develops dramatically and fruitfully in recent years. Moreover, many people fear that the construction of red mud reservoirs can generate “hanging bombs” over the lives of people who live in downstream regions (Tung, 2008). Another problem lies on the shortage of regional electric power and water supply, especially during the period of fast-paced economic development. At the national level, many lessons learned from natural resource exporting countries such as the Netherlands, Brazil, Nigeria, and Australia present challenges for the Vietnamese government. For example, in the 1960s, the Dutch agricultural and manufacturing industries were hampered by the natural gas exporting boom. The term “the Dutch disease” was subsequently coined by Corden and Neary (1982) to explain this phenomenon. In the study on the Brazilian economy, Auty (1995) claims that this country experienced a period of slow-paced economic

development despite its natural resource endowment, which is more favorable than many other countries; therefore, the existence of the “resource curse” in Brazil was evident. Since the extraction of natural resource is likely a double-edged sword for resource-rich countries, the projection of bauxite mining in the Central Highlands should be carefully examined to avoid adverse impacts on the regional and national economies.

This paper identifies the impacts that the bauxite mining plan has on the livelihoods of the local people in the Central Highlands and the Vietnamese macroeconomy. Within the scope of this paper, the potential impacts of the Tan Rai and Nhan Co projects, the major part of the Vietnamese government’s master plan are analyzed in economic, social, environmental, and cultural aspects. At a macroeconomic perspective, this paper determines whether these projects can unfavorably affect the national economy with the consideration of the “resource curse” and the Dutch disease phenomenon. Due to limited access to data, many impacts cannot be monetarily calculated; however, this paper may contribute to a comprehensive understanding of the potential consequences of bauxite mining in the Central Highlands and to the sustainable development of the Central Highlands in particular and Vietnam in general.

II. SUSTAINABLE DEVELOPMENT AND EXHAUSTIBLE RESOURCES

1. THE DEFINITION OF SUSTAINABLE DEVELOPMENT

The concept of sustainable development took the center stage in the debate over environment vs. development since the Brundtland Commission's book "Our Common Future" was published in 1987. Through the decades, many different definitions of sustainable development are introduced but the most widely quoted is:

Sustainable development is development that satisfies the needs of the present without jeopardizing the abilities of future generations to meet their own needs.

(World Commission on Environment and Development, 1987, para. 27)

This definition is quite brief; however, the interpretation varies. How can we estimate the 'needs of the present' and use resources to the extent that our consumption does not affect the consumption in the future? For many economists, "needs" could be understood as the "well-being" or "welfare" where social welfare is considered as a general stock of capital. The use of resources today needs to be maintained at a level that may not decrease the welfare of people in the future. To maintain development over time, the overall stock of capital of the country, thus, needs to be preserved (Pearce and Warford, 1993).

1.1. FORMS OF CAPITAL

The concept of capital is no longer limited to physical or monetary capital. Bourdieu (1986) categorizes capital in three main types: economic, social, and cultural capital while Coleman (1988) divides capital into physical, social, and human capital.

Simply, capital could be divided into two types: natural capital and man-made capital (Pearce and Warford, 1993, pg. 51-55). Capital could be a source of income or physical assets such as a computer, a house, a particular share in a company etc. Experience, social networks, health care, knowledge, and skills are also considered as capital because these factors partly help to improve labor productivity and raise income. In addition, human capital is embodied in the skills and knowledge acquired by an individual while social capital exists in the relations among persons (Coleman, 1988, pg. 100-101). Becker (1992, pg. 91) also gives an example of the success of Asian countries to emphasize the importance of human capital:

The outstanding economic records of Japan, Taiwan, and other Asian economies in recent decades dramatically illustrate the importance of human capital to growth. Lacking natural resources - e.g. they import practically all their sources of energy and facing discrimination from the West, these so called Asian tigers grew rapidly by relying on a well-trained, educated, hard-working, and conscientious labor force that makes excellent use of modern technologie[s]

Cultural and human capital share a similarity that they can be institutionalized through education. In the common interpretation of sustainable development, the cultural aspect of capital is not mentioned; however, as culture is part of national welfare, culture should necessarily be preserved and developed over time along with other types of capital.

1.2. THE OPTIMIZATION OF EXHAUSTIBLE RESOURCE EXTRACTION

Natural resources are categorized into renewable and non-renewable (i.e. exhaustible) resources. Trees in a forest are renewable while minerals like gold, bauxite etc. are considered nonrenewable because they cannot be reproduced. In regard to non-renewable resource extraction, many economists have tried to model the rate at which a non-renewable resource is depleted over time.

A broadly used microeconomic foundation is the Cobb-Douglass production function: $Y = AL^\alpha K^\beta$ where Y is the total output (the monetary value of all goods produced in a year), L equals labor input, K represents capital input, A is total factor productivity, and α and β are the output elasticities of labor and capital, respectively. Based on this function, Hotelling (1931) and Hartwick (1977) find that extraction will deplete a non-renewable resource over time, and one way to maintain consumption of the future generations is to invest in reproducible capital such as machines and infrastructure. Hartwick's finding was developed further by Solow and is widely known as the Hartwick-Solow rule, which suggests that investing resource rents (i.e. profits gained from the extraction of natural resources) in reproducible capital (i.e. machines, equipments, schools, roads etc.) is a sufficient condition to maintain consumption in the future. Thus, produced capital should sufficiently be accumulated to offset the depletion of exhaustible resource stock.

According to Hotelling (1931), an efficient extraction of a non-renewable resource should be that the percentage change in profit per unit equals the discount rate to maximize the present value of the resource capital over the extraction period. The optimal solution is illustrated by the function: $\delta = P'(t)/P(t)$ when $P(t)$ is the unit profit at time t and δ is the discount rate. The uncertainty of the environmental costs of economic activities, characterized as the underestimates of the potential costs, can lead to a reduction in net benefits from an activity and thus needs to be included in the estimation of the discount rate. Irreversibility is also another cost that must be included in the calculation of benefits from natural resource extraction. Irreversible extraction is considered as one that would be infinitely costly to reserve (Arrow and Fisher, 1974).

The extraction of non-renewable resources is an irreversible process as they cannot be reproduced once extracted.

Besides their economic values, natural resources encompass many ecological attributes. For example, land that is endowed with bauxite resources can be used for agricultural cultivation or tree planting. Instead of being used for firewood, forests could alternatively be used for eco-tourism. If the extraction of a resource brings a high amount of uncertainty, perhaps there is a more viable solution to generate economic opportunity. In the case of bauxite mining, if the mined land is returned to farmers and revegetated for cultivation after bauxite ores are extracted, the use of land for resource extraction is considered as a reversible process (i.e. the original condition of the land remains unchanged). Nevertheless, if the length of time required for revegetation is immense, the use of land might be considered as irreversible since the initial condition of the land cannot be restored.

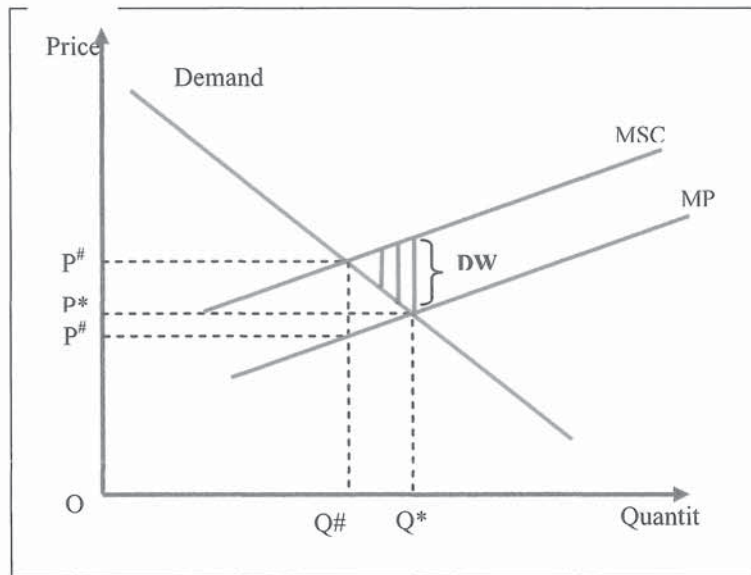
Weak sustainability advocates argue that manufactured capital of equal or higher value can completely substitute for natural capital. As non-physical capital can be converted into economic capital, resource rents from natural resource extraction should be wisely used to invest in other reproducible capital, which ranges from physical, human, social to cultural capital, to maintain the overall stock of capital in the future. For example, if a forest is cut to export wood, the export revenue should be used to replant the forest. Similarly, if bauxite resources are extracted, the revenue from bauxite exports should be invested in other types of reproducible capital. Investing in other industries and economic development for long term sustainability will compensate or alleviate the initial forest decline or bauxite resource depletion.

In contrast, supporters of the *strong sustainability* idea argue that capital substitutability has limits. In particular, manufactured or man-made capital cannot physically substitute for natural capital, e.g. once the arable land is used for mining activities, the primitive condition of the land cannot be recovered at any cost. In addition, the extraction of natural resources can result in many harmful impacts such as land erosion, flooding, the green house effect or household displacement. Therefore, an appropriate measure that fully includes possible social costs needs to be considered in a cost-benefit analysis or a project assessment.

1.3. SOCIAL COSTS

In economics, many theoretical models are built based on the assumption that markets function perfectly. If true, prices in the marketplace reflect the marginal private and social costs of production (i.e. no divergence between the two). Figure 1 illustrates a market in which a divergence between private and social costs presents and, therefore, the production process results in a negative externality (e.g. air or water pollution). The vertical distance between the marginal private cost (MPC) and marginal social cost (MSC), measured over the quantity of the good purchased represents the costs imposed on society by the externality. Figure 1 indicates that the market sets a low price for the good ($P^* < P^\#$) because it fails to evaluate the cost to society or the third party and thus, causes the deadweight loss (DWL) represented by the shaded triangular area. In light of cost internalization, the government must impose a per unit tax in order to internalize the externality and properly evaluate the social costs associated with resource use. As a result, the utilization of resource at Q^* would decrease to $Q^\#$ and the price would increase from $P^\# - t$ to $P^\#$.

FIGURE 1: MARGINAL SOCIAL COST VS. MARGINAL PRIVATE COST



Source: Boardman, A. E, Greenberg, D.H., Vining, A. R., & Weimer, D.L. (2006, pg. 85)

The calculation of social costs, however, normally underestimates the full costs. In particular, Pearce and Warford (1993) emphasize that in poor countries, the private cost in mining industries is relatively low because of the employment of unskilled labors and out-dated technologies. If the costs to clean air and water and to recreate lost biodiversity are included, the price of a ton of gold or bauxite would be prohibitive.

In cost-benefit analysis, the discount rate which is used to bring future values to the present is one of the most important elements to evaluate the feasibility of a project. Normally, a project is considered to be feasible if the net present value, the difference between discounted benefits and costs, is positive. The use of the traditional monetary cost-benefit analysis to determine whether sustainable development is worthwhile, nevertheless, presents some challenges. First, although many current and future costs could be estimated and discounted to the present value, we cannot know the exact types and amounts of costs that will be induced in the future. Second, the benefits of

sustainable development are more qualitative than monetarily quantitative as the value of a living species or the loss of social degradation and cultural disappearance are considered. Ethically, the benefits of life outweigh the costs to obtain it (Payne and Raiborn, 2001, pg. 160). Thus, discounting and pricing methods, in many cases, fail to fully evaluate the benefits and costs of natural resource extraction. Several supplemental approaches should be considered. For example, to offset the damage of using of a wetland, another wetland should be built elsewhere. Nevertheless, many on-site impacts such as land erosion, water and air pollution etc., cannot be relocated or rebuilt anywhere else.

The environmental impact assessment (EIA) is an important requirement for mineral mining projects in the project planning process. In many countries, the environmental laws clearly state that an EIA must be completed prior to project construction. If project contractors fail to comply with the EIA requirements, several forms of penalty are imposed. In Vietnam, the Environmental Law approved by the People's Committee in 2005 requires that an EIA must be completed simultaneously with project assessment procedures. An appraisal council in which over 50% of its members have professions, which specialize in environment and other areas related to the project, is established to evaluate the EIA.

2. ECONOMIC DEVELOPMENT AND ECONOMIC GROWTH

The concept of economic development is inherently much broader than that of economic growth. Economic growth simply implies an increase in quantitative output such as GDP or income per capita while economic development, which could or could not be attained with economic growth in tandem, refers to the improvement in a variety

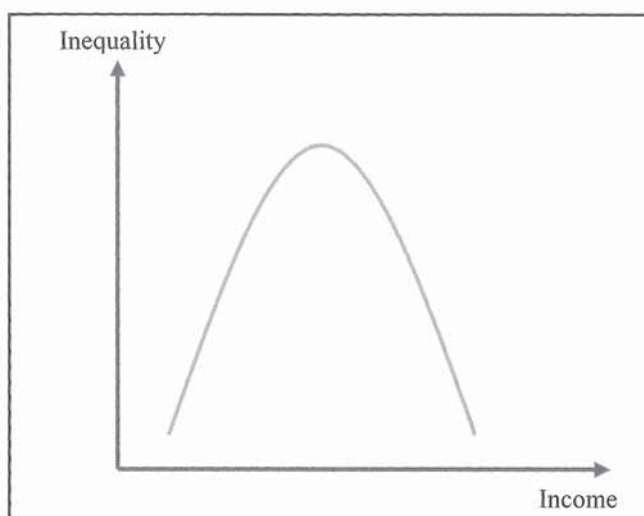
of indicators such as literacy rates, labor skills, environmental quality, social justice etc. Many past development policies were based on the idea that a country would go through a transition from agriculture to industry to service-oriented economy. During this transition, natural resources were mostly used in the first stage, from agriculture to industry, to achieve high rates of economic growth. That transition was commonly achieved at the cost of enormous damages to the environment such as deforestation, land erosion or water shortages.

During the 1980s, the debate on natural resource extraction focused on developing countries. Nevertheless, cost assessment of resource degradation and environmental pollution in the developing world is in its infancy; environmental destruction is widely accepted as part of the price for a country to achieve a higher standard of living. Many industrialized countries followed the economic development paths which largely depleted natural resources, especially in the first stages. Developing countries, however, do not necessarily have to replicate that development process as they can take advantage of fast-growing technologies (Pearce and Warford, 1993, pg. 29). For many poor countries, they also do not have substitutions for exhaustible resources as many industrialized countries did before. Moreover, many industrialized countries suffered harsh consequences for their ignorance towards environmental quality. As a result, they now exert great efforts to repair past damages like global warming. Therefore, developmental economic policies need to focus on preventative measures instead of reacting to damages after the fact.

Many people believe that inequality is a trade-off when a country achieves its growth objectives and is unavoidable in economic development stages. According to Kuznets (1955), economic inequality increases at the first stage of economic growth, and

eventually stabilizes over time, then begins to decrease in advanced stages of development. The growth-equity relationship is characterized as an inverted U (See Figure 2). According to Grossman and Krueger (1995), the turning point could be approximately \$8,000 per capita income. In the first stage, natural resources are used as one of the main sources to spur GDP; physical capital rather than human capital is heavily invested. When income per capita reaches a certain point, public investments will become diverted towards social and human capital.

FIGURE 2: THE KUZNETS CURVE



The inverted-U hypothesis has been empirically borne out by most countries over the last decades; however, Arrow et. al. (1996) claim that this relationship is ambiguous at least on two main points: whether economic growth is sufficient enough to cause environmental improvements and natural resources are capable to support indefinite economic growth in the future. Environmental degradation is a qualitative concept. For example, we definitely know that deforestation could affect the livelihoods of people, the hydro-cycle and the air locally, nationally, and globally, but we will never be certain of

the actual impacts at the present or in the future. In particular, developing countries would encounter many obstacles as they lack advanced technology, knowledge, and skills to cope with environmental issues. Economic growth that ignores the impact on the environment and society would lead to huge costs in the future. In many cases, these costs cannot be offset by the increase in GDP or income per capita. Thus, if natural resources are irreversibly degraded, then economic activities could be placed at risk and development would not be sustained.

In addition, Shrivastava (1995) emphasizes that sustainable development should be a duty of all social entities, not the only responsibility of the government. Government efforts need to be supplemented with new voluntary efforts by businesses to address the potential impacts on the economy, society, and environment. Businesses should actively engage in sustainable development activities to mitigate environmental impacts and to preserve a livable environment. Businesses also can undertake a strategy of pursuing sustainable development in conjunction with profitability to the benefit of their stakeholders. Such a strategy should consider both current and future eco-efficiencies.

The role of civil groups to protect the environment needs to be underscored as well. Initiatives should concentrate on civil groups who can offer prompt actions such as help rural and displaced people to make a living and to adapt to new habitats. For example, in Nigeria, civil groups have successfully obtained adequate compensation from mineral oil companies. Their achievements could be a good example for many other resource-rich countries to mitigate the negative impacts of the extraction of natural resources.

In summary, sustainable development is the appropriate extraction of resources to meet present demand with the consideration of associated ecological impacts. For many developing countries, Pearce and Warford (1999) suggest that the traditional development path which uses natural resources as the main source of growth in the industrialization stages should not be duplicated. Notably, excessive extraction of non-renewable resources will induce massive costs in the form of economic losses, biological degradation, and cultural disappearance. Given the controversy of the estimation of costs that occur during project assessment, the measure of costs should be broadly defined in order to capture the uncertainty and irreversibility of resource extraction as well as other impacts. Therefore, sociological costs should be included in the estimation of the discount rate as well as compensated in other ways, e.g. create a replacement habitat or invest in reproducible capitals such as schools, roads, education, and cultural conservation.

III. THE CASE OF BAUXITE MINING IN VIETNAM

Vietnam's development goals are ambitious: to become an industrialized country by 2020 and, more broadly, to build a "prosperous people, a strong country, and an equitable, democratic, and civilized society." (Dapice et al., 2008, pg. 7). In the last 15 years, Vietnam's poverty reduction and economic growth achievements are one of the most spectacular success stories in economic development. For example, income per capita increased from \$260 in 1995 to \$835 in 2007 and the poverty rate fell from 58.1% in 1993 to 16% in 2006 (World Bank [WB], 2009)³.

Sustainable development has been addressed as part of the socio-economic strategy by the Communist Party of Vietnam (CPV) since 2001.

Socio-economic development is to be closely associated with environmental protection and improvement, to ensure harmony between man-made and natural environment and to conserve biodiversity...[t]o proactively prevent and mitigate the negative impact of natural calamities and adverse climatic changes, and continue solving the remaining war consequences to the environment.

(CPV, Strategy for Socio-economic Development, 2001)

Many policies and announcements pertinent to bauxite projects in the Central Highlands also emphasize the importance of sustainable development.

[d]evelop high-technology and environment-friendly bauxite mining and processing industries...[e]nsure the sustainable development and participation in the world's alumina and aluminium market[s]

(Decree 91/BC-CP, Report to the National Assembly on the Implementation of Bauxite Projects, 2009)

³ See Report "Vietnam: Laying the Foundation for Sustainable, Inclusive Growth". World Bank. (2009, August). Retrieved November 11, 2009, from <http://siteresources.worldbank.org/IDA/Resources/IDA-Vietnam.pdf>

Many scientists, economists, and environmentalists assert that these objectives, i.e. “high-technology”, “environment-friendly bauxite mining and processing industries”, and “sustainable development”, are unlikely to be accomplished due to impracticalities. This chapter analyzes the impacts of the Tan Rai and Nhan Co projects as part of an ambitious master plan to extract bauxite reserve in the Central Highlands. The conclusion is that the implementation of bauxite mining and alumina refining will create enormous negative socio-economic impacts on the region, especially the livelihoods of indigenous people.

1. THE MASTER PLAN

The Tan Rai and Nhan Co projects are the most important part of the *Zoning Master Plan for Exploration, Mining, Processing and Use of Bauxite Ore in 2007-2015 Period*, which was approved by the Prime Minister of Vietnam on November, 1st 2007⁴. According to this plan, the world’s third largest bauxite reserve of which 90% is concentrated in Vietnam’s Central Highlands will be used to develop the bauxite, alumina, and aluminium industries. A total investment of \$11-\$15 billion is divided into two phases: Phase I (2007-2015) and Phase II (2016-2025). The master plan is projected to contribute to the socio-economic development of the Central Highlands as well as other related regions and the national economy. Infrastructure networks such as transport, electricity, and schools will be significantly improved and developed to serve indigenous people, especially the ethnic minority groups.

⁴ Prime Ministerial Decision No. 167/2007/QĐ-TTg dated 1st November, 2007, downloadable at <http://www.dgm.gov.vn/Modules/DeedDownload.aspx?DeedID=299>.

The total bauxite reserve in Dak Nong and Lam Dong provinces where the Nhan Co and Tan Rai projects are located is approximately 4.4 billion tons, which accounts for 81% of the Central Highlands's total bauxite reserve base. In July 2008, Vinacomin, a state-owned Vietnamese mining group, signed a contract with Chalieco to construct a bauxite-aluminium complex in Tan Rai commune in Lam Dong province. The second bauxite project in Nhan Co commune Dak Nong province is in the process of inviting bids for official construction work. Due to the lack of experience and advanced skills in mining bauxite, Vinacomin has to call for Engineering, Procurement, and Construction (EPC) contracts in the infrastructure period. Under the EPC terms, the Chinese contractor, Chalieco, is exclusively responsible for the design, installation, and technology used in the alumina production.

According to the master plan, the project life is 30 years (2007-2036) in which the infrastructure period spans from 2007 to 2010 and the operation phases will commence in 2010. Total capital investment is approximately \$1.3 billion. Moreover, the construction of two hydroelectric plants and a red mud reservoir is required for the supply of water and electric power for bauxite sifting and alumina refining activities. A railway, which connects project areas to the Ke Ga exporting sea port in Binh Thuan province (see Figure 3), will be built to transport bauxite and chemicals used for alumina production. The estimated investments for the railway and sea port system are \$3.1 billion and \$500 million, respectively.

The rationale for these bauxite mining projects is officially confirmed by the Vietnamese government in many announcements and decisions:

[b]uild up bauxite, alumina and aluminum industries in order to develop the national economy in general and partly contribute to the socio-economic development of the Central Highland[s]
(The Politburo, Announcement 245, 2009)

and

[a]lumina producing and aluminum smelting factories must be located at the Dak Nong province to boost up the transition of the economic and labor structure, create more jobs, and increase the incomes of the local in the Central Highlands in general and in Dak Nong province in particular.
(The Politburo, Announcement 14-TB/TW, 2006)

As previously mentioned, the Vietnamese Deputy Minister Nguyen Sinh Hung claims that the bauxite plan aims to develop bauxite, alumina, and aluminium industries and to contribute to the socio-economic development of the country and the Central Highlands in particular.

FIGURE 3: THE TAN RAI AND NHAN CO BAUXITE MINING PROJECTS AND THE KE GA SEA PORT



In recent years, crude oil is a main contributor to Vietnam's GDP and accounts for 12% to 18% of the total export revenue (General Statistics Office of Vietnam [GSO], 2009). Since oil and coal, the main mineral exports of Vietnam, gradually are depleted, the discovery of high concentration of bauxite reserves in the Central Highlands will replace oil as a new driving force for the country's GDP in the next several decades. The computations of costs in these projects; however, have apparently ignored enormous social costs, which should encompass the compensation for the loss of biodiversity, environment pollution, water and electricity shortages, and other negative impacts on the livelihood of millions of people who live near the plateau and the downstream region.

2. DESCRIPTIONS OF THE TAN RAI AND NHAN CO PROJECTS

The total investment for the Tan Rai and Nhan Co projects is approximately \$1.3 billion. In the Tan Rai project, Vinacomin, holds 51% of the capital investment while Chalieco holds the remaining 49%. For Vinacomin, capital is mobilized from many sources such as shareholders, commercial banks and international banks, stock market, government bonds, and ODA funds. The interest rate for the investments of Tan Rai and Nhan Co projects is approximately 5% with the principal payment rate of 2%. (See Table 1 for brief descriptions of the project activities)

As stated in the master plan, an export sea port will be built in Ke Ga Cape in Binh Thuan coastal area to serve the aluminum industry in the Central Highlands and the central southern region. The port will accommodate ships of 30,000 – 50,000 ton capacity. The cargo handling capacity of the port is estimated to be approximately 10 – 15 million tons per year (tpy) in phase I (through year 2015) and about 25 – 30 million

tpy in phase II (through year 2025). The total investment for the sea port is estimated to be \$500 million.

TABLE 1: THE TAN RAI AND NHAN CO PROJECT DESCRIPTIONS

Items	Unit	Tan Rai	Nhan Co	Note
Total investment	Billion USD	628	697	With annual interest and principal payment rate of 7%
Capacity of mining bauxite	Million tons	1.2	1.2	Tan Rai, Lam Dong province and Nhan Co, Dak Nong province
Alumina output	Million tons	0.6	0.6	Increased output of 1.2 million tpy in Phase II (2016-2025)
Water use	Million m ³ per year	1.5-2	1.5-2	Build Cai Bang and Dak R’Tih hydroelectricity plants to supply water and power
Electricity	KWh per ton	200-256	200-256	
Labor	Person	1,600	1,600	
Red mud and tailing slurry discharge	Million m ³ per year	0.8	0.6	Construction of a red mud reservoir with a capacity of 20-25 million m3 in an area of 500 ha
Land use				
<i>short term</i>	Hectare per year	50-60	50-60	1-2 years for bauxite mining activities
<i>long term</i>	Km ²	23	100	30-50 years for infrastructure such as bauxite refining, water reservoirs, red mud and tailing slurry reservoir, resettlement areas
Displaced households	Household	1,600	760	
The Ke Ga export sea port in Binh Thuan province	Million USD	0.5		Support of the master plan, including Tan Rai and Nhan Co projects
Railway system connecting Dak Nong-Lam Dong-Binh Thuan	Billion USD	3.1		

A railroad system, which requires an investment of \$1.3 billion, is planned to support bauxite mining and alumina processing activities. In the 2007 - 2015 period, a

single track will be built and then be upgraded to a double track in the period after 2015. In 2007 - 2015 period, the railroad is expected to run from project areas in Dak Nong province through Lam Dong province to the Ke Ga sea port; in the period after 2015, the railroad is planned to extend to Binh Phuoc alumina plant. The transportation capacity in phase I (through year 2015) will be approximately 10 – 15 million tpy, in phase II (through year 2025) will be approximately 25 – 30 million tpy. Nevertheless, many experts claim that the projected capacity of this railroad system is only sufficient to serve bauxite mining and alumina refining activities and is unable to offer any secondary transportational services.

In terms of electricity supply, an 83-megawatt hydroelectric plant is built to supply water and power for the Tan Rai project. This plant uses water supplied by Cai Bang pond which holds a water capacity of 108 million m³. To meet the demand of the Nhan Co alumina refinery, a 140-megawatt hydroelectric plant is built in Dak R' Til commune in the Dong Nai river valley. Water from Dak R' Til stream is used to supply Dak R'Til pond which holds a water capacity of 138 million m³. While the total investment for the Dak R'Til plant is approximately \$200 million, the cost of the Cai Bang hydroelectric plant is unknown.

The total land use for bauxite mining projects in Dak Nong is approximately 1,605 km², which accounts for 24.6% of the local land area, of which 679 km², which accounts for 42.3% of the bauxite area and 9.2% of the local land area, is used for bauxite mining activities. In particular, the implementation of the Nhan Co project requires a total mining and refining area of approximately 100 km², which accounts for 1.53% of the local land area. Similarly, the total land affected in Lam Dong province is approximately

206.5 km², which accounts for 2.1% of the total area, of which 140 km² is for mining sites, which accounts for 68% of the bauxite area and 1.4 % of the local land area. The implementation of Tan Rai project requires the total mining and refining area of 23 km², which accounts for 0.3% the total land area. Since a small portion of the land is used for bauxite mining projects, the major concern lies with the displacement of the inhabitation. In fact, 1,600 households in Tan Rai project area are displaced and 700 households must resettle to other areas. Of this number, 230 households are from ethnic minority groups. In the Nhan Co project, the number of households that must resettle is 760.

3. SOCIO-ECONOMIC, ENVIRONMENTAL, AND CULTURAL IMPACT ASSESSMENTS

3.1. UNCERTAINTY AND IRREVERSIBILITY

Bauxite reserves in the Central Highlands is a non-renewable resource. As a national asset, they belong to both current and future generations. Thus, if the rationale for bauxite mining is to meet “the needs of the present”, the needs of future generations should be considered to maintain the sustainable development of the region in particular and the country in general. Inherently, the extraction of bauxite resources raises a great deal of uncertainty in regard to potential ecological impacts such as red mud discharges, water and electricity shortages, social conflicts, and the loss of culture.

As previously discussed, the extraction of bauxite is an irreversible process. Many developing countries such as China aggressively have extracted its natural resources; however, it lacks the advanced technology and knowledge to cope with social and environmental impacts. As a result, social conflicts and environmental degradation are pervasive in bauxite mining and alumina refining areas (Loan, 2008). The choice of an

appropriate social discount rate, thus, is crucial to ensure all associated costs are fully included in the project economic efficiency assessment or cost-benefit analysis.

Due to limited access to the project information, secondary data was drawn from the economic efficiency analysis (EEA), which was provided by Vinacomin in 2008, to analyze the economic efficiency of the Tan Rai and Nhan Co projects (See Table 2). Remarkably, the calculations of monetary benefits from projected revenues are financially flawed for several reasons: a low discount rate, a downward trend of alumina price in the long run, and many social costs associated with bauxite mining and alumina refining activities.

TABLE 2: ECONOMIC EFFICIENCY ANALYSIS

Items	Unit	Tan Rai	Nhan Co
Total investment	Million USD	628	697
Operating costs	Million USD	223	241
Selling price	USD/ton	362	310
Annual revenue from 2012	Million USD	213	207
Profit from 2012	Million USD	78.56	45.63
Discount rate	%	9.41	9.41
IRR	%	11.57	9.43
Breakeven point after	year	13.29	14.74
Tax contributions	Million USD	36.35	30.61
Corporate tax 28%	Million USD	21.44	16.03
Alumina export tax 5%	Million USD	10.88	10.34
Royalty (natural resource tax 10% charged to Chalieco)	Million USD	1.11	1.11
Environmental fee	Million USD	2.92	3.13

Source: Vinacomin, 2008⁵ (as cited in Vietnam Union of Science and Technology Associations [VUSTA], 2008, pg. 208-211)

⁵ According to Vinacomin's calculations, Nhan Co project will not be profitable if only one of the following conditions occurs: 1) alumina export tax exceeds 5%, 2) environmental fee exceeds \$0.9 per ton, and 3) alumina selling price is lower than \$310.

According to the EEA, with a common discount rate of 9.1%, the Tan Rai and Nhan Co projects are expected to generate a profit after 13 to 14 years of operation. This discount rate seems to be low for two reasons. First, the market discount rate rather than the social discount rate is applied. Thus, many social costs associated with bauxite mining activities are excluded from the calculation of benefits. Second, the rate of 9.1%, even if social costs are included, is low in comparison to conventional rates applied for similar projects, locally and internationally. The discount rate of 9.1% is lower than the World Bank discount rate, which ranges from 10% to 12%. According to the Institute of Transportation Studies (2003), the choice of discount rate is very complicated and varies among countries, particularly in developing nations. A discount rate lower than 10% is unlikely to be justified because the cost of capital in those countries is commonly higher than 10%. For example, a social discount rate adopted in the U.S. ranges from 7% -10% while in Asia, it is 12%-15% for the Philippines and Pakistan, 12% for India, and 9%-11% for China (Zhuang J., Liang Z., Lin T., & Guzman F. D., 2007, pg. 17).

Moreover, both projects are expected to obtain an internal rate of return (IRR) of 11.57% and 9.43%, respectively. It should be emphasized that the measurement of IRR does not incorporate some factors such as the interest rate of the project or the inflation rate of the economy. In recent years, the inflation rate in the Vietnamese economy averages 5% to 7% (Dapice et al., 2008, pg. 44). Also, the interest rate, which include the principal payment of 2%, for both projects is estimated to be 7%. Thus, if the inflation and interest rates are deducted from the IRR, the real rates of return for both projects are negative. In other words, these bauxite mining and alumina processing projects are

financially ineffective and inefficient. Consequently, other estimated monetary benefits such as revenues, profits, tax, or royalties are difficult to accurately project.

3.2. ALUMINA PRICE

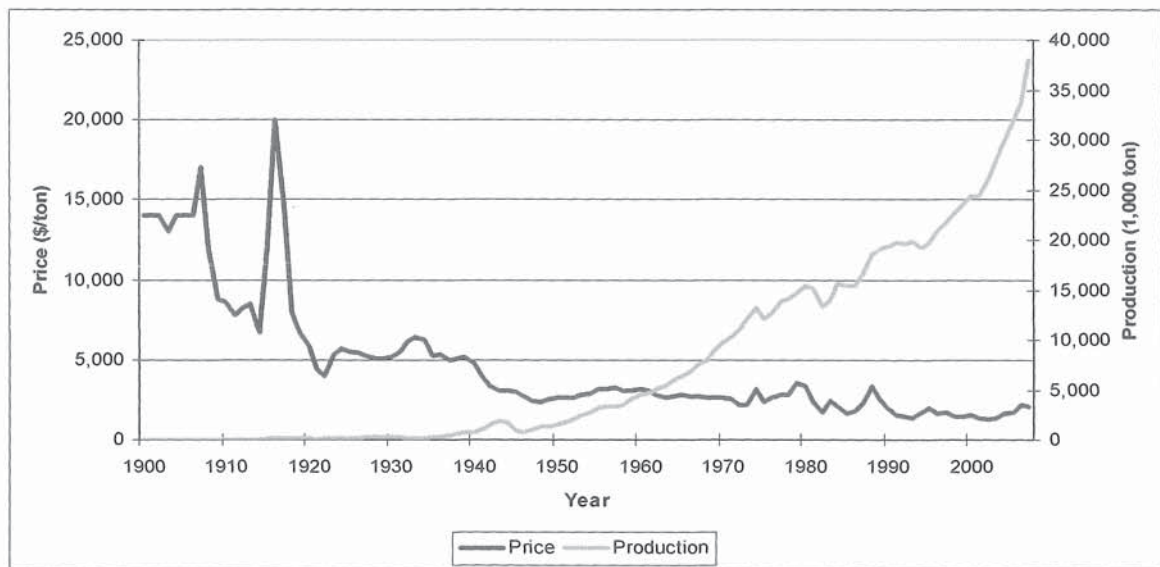
In the EEA, the selling prices of the Tan Rai and Nhan Co projects are estimated at \$362 and \$310 respectively when these projects achieve full operation in 2010. These prices, however, were calculated in 2007, one year before the world financial crisis occurred. As mineral prices are highly sensitive to the world's economy, these estimated selling prices are hardly realized because of three main reasons: the current economic recession, the long-term trend of the world alumina price, and the oligopolistic power of the Chinese investor.

First, the current financial crisis has led to economic shrinkages across the world. The price of aluminium, as a result, faced a significant downward trend. After a high of \$3,250 per ton in July 2008, aluminium prices in the world markets plummeted to \$1,300 per ton in February, 2009, equal to 40% of its peak price (Elliott, 2009). The price of alumina, approximately equal to 12%-13% of aluminium, decreased accordingly, from \$422 to \$156 per ton. As many production sectors such as automobile, airlines, and packaging were severely affected, the world's demand for aluminium shrank significantly. Aluminium price, as a result, will unlikely rebound to their peak in the next few years.

Second, some would argue that the economic recession will be short-lived, and alumina prices eventually will reach a constant average for the entire 30 years of the project life. Nevertheless, a steady downward trend of the world aluminium price since

the 1920s runs contrary to this belief. The figure 4 below illustrates the 1998 dollar price and world consumption of aluminium during the 1900-2007 period.

FIGURE 4: WORLD ALUMINIUM PRICE AND PRODUCTION, 1900-2007



Source: Aluminum Statistics, USGS, 2008

Note: The Consumer Price Index conversion factor, with 1998 as the base year, is used to adjust unit value in current U.S. dollars to the unit value in constant 1998 U.S. dollars. World Production: Data are defined as world primary aluminium production.

The world aluminium prices and production show two opposite trends: the constant declination of aluminium price since the mid-1930s and the rapid increase of aluminium production since the mid-1990s. In a 1995 study on mineral resources, Hodges mentions several reasons to explain why world aluminium supplies are adequately maintained despite an apparent limit to natural resources. Besides new discoveries, rapid technological advances have delivered new materials and new products, such as ceramics and composites, to replace the use of aluminium in many manufacturing sectors, especially construction, packaging, and automobiles. Moreover,

Hodges asserts that recycling efforts have increased significantly throughout the industrialized countries. Recycled scrap is a cheaper source of metals, because of lower energy consumption, and is profitable since production from scrap uses approximately 5% of the energy required to produce the metal from bauxite ores.

Third, the aluminum industry can be best characterized as an oligopoly with vertical integration through bauxite mining, alumina refining, aluminum smelting, and fabrication. Only those who can establish and manage the full production cycle in a highly efficient way can become leaders in this industry. The transformation of aluminium from alumina requires a large amount of electric power. Therefore, the price of power is a critical cost element in development of the aluminium industry. At present, 24 countries are extracting bauxite around the world. The 12 most productive countries produce 97% of total bauxite production. In 2007, China's alumina output was 19.46 million tons, which accounted for 25% of total world output, electrolytic aluminum output was 12.56 million tons, which accounted for 32.8 % of the world' total, and processed aluminum products were 11.76 million tons. In addition, China consumed 26.12 million tons of alumina, which accounted for 35% of total world consumption and 12.1 million tons of electrolytic alumina, which accounted for 32 % of the world's total (International Institute of Sustainable Development [IISD], World Wildlife Fund [WWF], & Heinrich Böll Stiftung, 2009, pg. 1). In recent years, China develops a huge thirst for natural resources and becomes the world's largest consumer of almost every metals. In 2002, China was the world's chief consumer of alumina, zinc, and nickel (Rutherford J., Lazarus K., & Kelley S., 2008, pg. 1).

In addition, the Chinese government established a 10-year strategy to proactively make use of overseas natural resources. This strategy, which intends to meet the country's growing demand for natural resources, aims to subsidize investments by Chinese companies in the acquisition of natural resources overseas. During the 1990s, China invested in various mining projects overseas, and by the 2000s that investment had increased significantly (Rutherford et al., 2008, pg. 53).

Thus, along with China's rising domination in the world's alumina production and consumption, 49% of the investment in the Tan Rai EPC project enables Chalieco to control the price of alumina produced in Vietnam. In addition, Chalieco can also benefit from the proximity between two countries as the transportation costs of alumina exported to China are much lower than those exported to other countries such as Australia or the U.S.. While Chalieco can earn a profit from low-cost production in Vietnam and sell alumina back to China at low prices, a passive role in these projects makes it impossible for Vinacomin to control the price and the exportation of alumina, let alone to become more powerful in the international alumina market in the long run.

3.3. SOCIAL COSTS VS. OPERATING COSTS

According to the EEA, the total operating cost for the Tan Rai project is \$223 million and \$241 million for the Nhan Co project; however, these costs failed to include many costs inherent in bauxite mining and alumina processing activities. Several costs such as the construction of red mud reservoir, transportation system, and land reimbursement are quantitative, but other costs such as health problems and loss of cultural identity are more difficult to quantify.

3.3.1. INFRASTRUCTURE SYSTEM

As scheduled in the master plan, a railroad and sea port system with total investment of \$3.6 billion will be built to support the production and exportation of alumina and to improve the infrastructure of the Central Highlands. Thus, partial depreciations of the infrastructure system should be included in the operating costs of alumina production. Moreover, as the total investment in infrastructure is substantial in comparison to the total investment of these projects (i.e. \$3.1 billion vs. \$1.3 billion), if the depreciation is included in the operating costs, these projects cannot make a profit as estimated.

3.3.2. RED MUD AND TAILING SLURRY DISPOSAL

The greatest concern associated with the bauxite mining lies in the impact of the red mud (i.e. bauxite residue) and tailing slurry (waste water discharged during the sifting process) on the Central Highlands' environment and its downstream region. Bauxite is the principal ore for the production of aluminium metal via a two-stage process: the refining of bauxite to alumina by a wet chemical caustic leach process (the Bayer process used by Chalico) and the electrolytic reduction of alumina to aluminium metal. Normally, 85% of bauxite mined is used to produce alumina for the production of aluminium. To produce one ton of alumina at least two tons of bauxite are required and 1.5 tons of red mud or bauxite residue are discharged. With the average capacity of 0.6 million tpy, each project will discharge 0.9 million tons of red mud each year or 27 million tons after 30 years of operation (if the capacity of these projects is upgraded to 1.2 million tpy, the total discharge will be significantly larger). As a result, for the entire project life, the total discharge produced by both projects will be approximately 54

million tons, which, according to Vinacomin's calculations, is equivalent to 42 million m³. Nevertheless, the Chinese technology to dispose of the wet red mud are out-dated. Whereas industrialized countries such as Australia have developed "dry stacking" technology to reduce the risks of waste disposal, Chalico continues to use the "wet deposit" system, which could contaminate water resources and damage biodiversity in the Central Highlands and the Dong Nai river watershed.

A red mud reservoir in which the interior of the reservoir is lined with 12-14 inch clay sealant is planned to be built in the Central Highlands. The total capacity of this reservoir is approximately 20 million m³; however, its ability to resist the weather in the Central Highland is technologically untested, which raises many concerns about the potential impacts on the environment if the reservoir fails. On the one hand, the reservoir will be constructed on highly arable lands and is designed to hold 15-30 years of mud storage. On the other hand, the 20-million-m³ capacity of the red mud reservoir holds only half of the estimated red mud discharge produced by both projects. The absorbent of caustic soda (used to extract alumina from raw bauxite) into the groundwater supply will increase sodium concentration of water sources in the Dong Nai river watershed. So far, the investors have not proposed any plan to preserve and process red mud discharge after the first reservoir is full. The costs to build red mud reservoirs, along with the costs to preserve and process red mud during and after project operations, are immense and should be included in the social costs of these projects.

Dust and caustic soda contamination are also of great concern. The particularly small size of both raw bauxite and alumina very often affect areas downwind of mining, transport, calcining, and ship loading operations. The dust is chemically inert; however, it

could adversely affect the respiratory system, pollute the residential cisterns, and deface property. Given the remoteness of the mine from inhabited settlements, the risk of adverse health effects in communities neighboring the mine is considered negligible but a variety of atmospheric emissions may harmfully affect the health of people working at bauxite mines.

3.3.3. WATER AND ELECTRICITY SHORTAGE

By over-investing in hydroelectricity, Vietnam now faces potentially crippling power shortages during the dry season when reservoir levels are low (Depice et. al., 2008). Electricity shortages also occur in the Central Highlands and, therefore, the production of alumina will increase shortages of water and electricity.

Alumina production is a power-consuming industry as approximately 200-256 KWh is required to produce a ton of alumina. To meet the electricity demand, a 83-megawatt hydroelectric plant is scheduled to be built to supply water and power for the Tan Rai project. This plant will use water supplied by the Cai Bang pond with a capacity of 108 million m³. To meet the demand of the Nhan Co alumina refinery, a 140-megawatt hydroelectric plant is planned to be built in Dak R' Til in Dong Nai river valley. Water from Dak R' Til stream will be used to supply Dak R'Til pond with a capacity of 138 million m³. According to Vinacomin, the annual total water usage of each project is approximately 15 million m³ in which 12 million m³ is used for sifting bauxite ores and 2.4-3.0 million m³ for aluminium production. The existing Nhan Co reservoir will supply water for the Nhan Co project and the Cai Bang reservoir will supply for the Tan Rai project and public use. The construction of hydroelectric plants in the Central Highlands,

however, has been questioned by many experts due to the fact that this region is suffering a severe shortage of water in the dry season.

In the Central Highlands, surface water is commonly abundant during the wet season, but in short supply during the remainder of the year. While the average rainfall in Dak Nong and Lam Dong is approximately 2,000-2,500 mm per year, 80% of the rainfall occurs during the wet season (from May to September). In the dry season, the average rainfall is extremely low, merely 10 mm per year. The shortage of water in the Central Highlands, along with dammed water for hydroelectricity production, will deepen water scarcity problems in the lower-lying sections of the Dong Nai river valley. The watershed of the Dong Nai River is the most important source of water for approximately 20 million people in 12 provinces and for thousands of firms, which include agricultural and river tourism activities in the downstream region. In 2005, the issue of water scarcity in Dong Nai river system started to raise concerns. The 2005 per capita water supply was 2,486 m³ per year, below the standard of 4,000 m³ proposed by the International Water Resource Association (Department of Water Resources Management, 2008). Per capita water supply across the Dong Nai river valley will decrease from 2,098 m³ per year in 2010 to the scarcity level of 1,475 m³ per year in 2040. As water is vital for life, water shortages can potentially create social and economic conflicts.

3.3.4. RESETTLEMENT

In fact, 40% of appropriated land in the project area is actively cultivatable and farmers earn approximately \$3,400 each year from coffee, tea, and other industrial crops. Although this annual income is low in comparison to other regions in the Central Highlands, the loss of agricultural land is significant and should be included in project

costs. In addition, due to the implementation of these projects, 1,600 households in Tan Rai commune must relocate and 700 households of which 230 households are ethnic minority groups. In the Nhan Co project area, the number of households to resettle is estimated to be 760. People in the resettlement area would find it difficult to restart their business or farming activities and adapt to the new environment. Resettlement areas, which are remote and scattered, lack well-built infrastructure and facilities to support daily life. Losses such as housing, jobs, and land receive compensation at lower than market value prices. For example, the average monetary compensation for each household is approximately \$2,200 per ha (Vietnetcenter, 2009), which is insufficient to relocate a family, let alone start new businesses to earn a living.

Besides inadequate monetary compensation, little attention is paid to the social changes due to resettlement. As most local people in the project area farm for a living, they face difficulties in a new area where land is not adequate for cultivation. Moreover, among those affected households, many are minority ethnics who habitually live in scattered areas. These highlanders are forced to move into new collective resettlement areas which are completely different from their nomadic styles of living, one important element that forms their unique traditional culture.

In recent years, those rural people in Vietnam who are dislocated due to urbanization lose their traditional farming activities. Lacking skills and knowledge pertinent to urban job markets, many displaced farmers quickly become jobless and poverty-stricken. As a result, social evils such as crime and robbery have increased rapidly in new resettlement zones and more social pressure is placed on urban cities due to the influx of people from rural areas. Other concerns focus on the income inequality

among those who gain from new businesses and those who lose jobs and income. Economic isolation often is accompanied by a decline in social status in society among the displaced.

3.3.5. LOSS OF CULTURAL IDENTITY

Renowned for its richness and uniqueness in cultural diversity, the Central Highlands embraces a large potential of cultural capital. The extraction of bauxite reserves raises concerns over the loss of cultural identity as land and highland living environment holds the traditional culture of the ethnic people.

In recent years, due to an influx of people from downstream regions, social disorders and cultural degradation have taken place in the Central Highlands. The ratio of ethnic minority groups to total population has decreased dramatically. For example, indigenous minorities such as the Ede and the H'Mong comprised 48% of Dak Lak's population, but now only represent 20% of the population. In addition, the ethnic minorities from the Northern Highlands such as Tay and Nung comprise 10% of the population while the Kinh and other ethnic groups comprise 70% (D'haeze et. al., 2005). In fact, the Kinh and Hoa (i.e. the Vietnamese-Chinese) have substantially higher living standards than other ethnic minority groups such as H'Mong, Ede, Gia-rai, Ban-na, and Xo-dang, which, however, are renowned for their cultural identities. In particular, the Gong cultural space of the Central Highlands was recognized as the Masterpiece of the Oral and Intangible Cultural Heritage of Humanity by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) on November 25, 2005. Nevertheless, along with living standards, the cultural identities of these ethnic groups are threatened by

rapid economic development (Baulch et al., 2006). The displacement of minority groups due to bauxite mining activities can intensify social conflicts and economic inequality.

In addition, the Central Highlands is distinguished in its natural beauty with forested mountains and coffee plantations. In 2008, the Central Highlands was the largest coffee producing region and accounted for over half of the nation's total coffee crop. In recent years, advanced agricultural cultivation produced higher yields which increased income and improved living standards for local people in the region, but the western highland area of the region lost much of its natural beauty. Some remnant forests remain, but most of the trees were either destroyed by agent orange during the Vietnam War or stripped for agriculture. Nguyen Ngoc, a novelist specializing in the culture of the Central Highlands, claims that mistakes in economic policies over the past few years have broken down the unique blend of highland villages and tropical forests in the Central Highlands (as cited in Hoang, 2006, para. 3). For indigenous people, forests are a vital part of their livelihoods. Unlike people who live in rural areas, most indigenous people live in an ecological system surrounded by tropical forests, land, water, fauna and flora, climate, and highland villages along with cultural traditions, customs, and mores. As the society and its natural environment are interdependent, any impact on one element would impair the entire system. Thus, the government and investors should take into account economic, social, and cultural considerations before Vietnam invests in the bauxite extraction projects.

3.4. MANAGEMENT

Public administration and project management are important part of obtaining high efficiency and effectiveness in public investments. In Vietnam, however,

management skills are very weak between the governmental system and state-owned corporations. For example, the Incremental Capital Output Ratio (ICOR) index, which is widely used to measure the efficiency of a country in public investment, during 2000-2006 period was 4.4 while the average ICOR index of other countries in the region is approximately 3.0 (Dapice et al., 2008, pg. 38). With a high ICOR index, the Vietnamese government needs more investment capital to reach 1% in GDP growth. Corruption and waste in public investment projects, which are inadequately planned and managed, are main reasons for this high ICOR. In particular, along with public disclosure, Vietnam's mining industry lacks transparent tax regulations, efficient royalty structures, and more complicated regulatory systems (Rutherford et al., 2008); therefore, many policies are poorly designed, which result in irreversible environmental and social impacts on mining regions across the country. For example, Vinacomin is criticized for its mismanagement in coal mining activities over the last decade, which is followed by disastrous environmental pollution and adverse impacts on the livelihoods of local people in Quang Ninh province (Triet, 2009).

One concern about project assessment is the lack of well-defined requirements for the environmental impact assessment (EIA) in the mining industry. In Vietnam, experiences have shown that the EIAs are only prepared to meet the minimal government requirements and environmental issues are only mentioned in a general sense. The implementation process is loosely monitored and commonly ignores public opinions and engagements. In addition, environmental restoration plans usually fail to comply with EIAs. Since most mining projects are run by state-owned companies who are also the EIA planners, a conflict of interests emerges. EIA planners intentionally set very low

environmental standards to minimize operating costs, which enable them to gain more profits, while all environmental requirements are legally met.

3.5. THE RESOURCE CURSE AND THE DUTCH DISEASE

Since the 1980s, many economists try to examine the reverse relationship between resource abundance and economic growth in the developing world. Empirical evidence shows that resource exporting countries suffer from poor economic growth, which becomes a “curse” for those countries in their efforts to develop the economy. One of the most important empirical results was found by Sachs and Warner in their book “Natural Resource Abundance and Economic Growth” (as cited in Ross, 1999, pg. 300). In this study, they examine 97 countries over a 19 year period to measure the impact of mineral and other resource exports on GDP growth. The study results show that countries with a high ratio of natural resource exports to GDP in 1971 experienced unusually slow growth between 1971 and 1989.

Although the debate over a clear-cut explanation for the “resource curse” hypothesis has not been settled, many studies share a number of common conclusions. On the one hand, for most developing countries that have surpluses of labor but shortages of capital, the easiest way to boost economic growth is to extract and export their natural resources in the form of primary commodities. In addition, foreign investments in resource extracting projects are also encouraged to increase national revenues and finance other investments in public goods. On the other hand, resource exporting nations may risk economic slowdowns for several reasons. First, a decline in the terms of trade, which are the relative prices of a country’s exports to imports, is likely to occur. Second, the fluctuations in the international commodity markets challenge the government in an

effort to stabilize national revenues, foreign exchange reserves, and public investments. Third, foreign investors are likely to transfer their profits to their home countries rather than invest them in the host country. More importantly, from a political viewpoint, poor performance of resource exporters is largely due to political issues such as the shortsightedness of bureaucrats, the influence of privileged classes and interest groups, and the weaknesses of governmental institutions to implement property rights and to control rent-seeking activities (Ross, 1999, pg. 298-308).

One potential problem associated with resource extraction is that the development of the alumina industry hampers the country's manufacturing and agricultural sectors. As coined by Corden and Neary (1982), the Dutch disease is an economic concept that explains the negative impacts of a booming extractive sector on the manufacturing sector. According to this theory, the booming sector refers to the extraction and exportation of minerals such as oil, natural gas, bauxite, copper, gold etc., while the lagging sector refers to the manufacturing sector, including agriculture. The occurrence of a booming sector is followed by two effects: the resource movement effect and the spending effect. The resource movement effect refers to a switch of employment from lagging sector to the booming sector. In the spending effect, labor from the lagging sector tends to shift to the non-tradable good sector (i.e. service sector) as the increase in revenue brought by the extractive sector leads to an increased demand in services. While demand for tradable goods is largely driven by foreign countries, an increase in the demand for non-traded goods leads to an increase in the prices of these goods at home, which result in an appreciation of the domestic currency. When the domestic currency is appreciated, export goods are dearer and less competitive in the international markets, which leads to a

decline of the manufacturing sector. In general, the Dutch disease is associated with four main symptoms: a slowdown in manufacturing output, a booming non-tradable sector, an increase in employment and real wages, and a real exchange rate appreciation (Beck R., Kamps A., & Mileva E., 2007). Nevertheless, during the past few years the exportation of crude oil, the major mineral of the Vietnam mining industry, significantly contributed to the country's export revenue while other industries, which include manufacturing and agricultural, showed no sign of slow growth.

As the share of bauxite in the 2007 GDP is smaller than that of crude oil, which is the Vietnam's major export in recent years, the development of alumina industry is unlikely to induce the Dutch disease for the Vietnamese macroeconomy. In the last seven years, oil export revenue accounted for 12% to 18% of the total export revenue. In 2007, revenue from crude oil exports was \$8.59 billion, which accounted for 16% of the total export revenue. In 2007, the share of export revenue in total GDP (i.e. \$68.6 billion), was 77% (See Table 3). Thus, oil export represents 12% of Vietnam's 2007 GDP.

TABLE 3: VIETNAM MACROECONOMIC INDICATORS⁶

	Unit	2000	2007
GDP	Billion USD	31.0	68.6
Agriculture	% of GDP	25	20
Industry	% of GDP	37	42
Services	% of GDP	39	38
Export of goods and services	% of GDP	55	77

⁶ Data is collected from the World Bank's website, Vietnam Data and Statistics section, retrieved Nov. 2009.

According to the master plan, bauxite mining projects in Nhan Co and Dak Nong provinces are expected to contribute 1.2 billion tons of alumina annually. From 2012 onwards, both projects will add \$420 million (\$213 million from the Tan Rai project and \$207 million from the Nhan Co project) to Vietnam's export revenue and accounts for 0.6% of the 2007 GDP. Even if the total estimated capacity of the master plan for the entire 2007-2025 period is considered, the ratio of alumina export revenue to GDP will unlikely be higher than that of crude oil. (See Table 4)

TABLE 4: ESTIMATED PERCENTAGE OF THE ALUMINA EXPORT IN THE 2007 GDP⁷

	Unit	2007-2015 period	2016-2025 period
Total capacity of alumina production	Million tons per year	6.4-8.4	12.8-18
Total revenue (at the estimated price of \$300/ton)	Billion USD per year	1.9-2.5	3.8-5.4
Ratio of estimated export revenue to the 2007 GDP (\$68.6 billion)	%	2.8-3.6	5.6-7.9

Vietnam's manufacturing sector has not declined over the last several years although its GDP has been highly dependent on crude oil exports. From 2000 to 2007, the GDP share of the processing industry increased from 18.8% to 24.5% while the mining industry's share in GDP decreased from 6.7% to 4.9%. Overall, the non-traded goods sector, which includes trade, construction, transportation, education, and finance, witnessed a slight increase. Although the share of agricultural products in total GDP declined from 23.3% to 17.9% in the 2000-2007 period, the share of agricultural and

⁷ The total capacity of alumina production is collected from the projection of the master plan. Total revenues equal to total productions time the estimated unit price of \$300 per ton of bauxite. The 2007 GDP is provided by the World Bank, see Table 3.

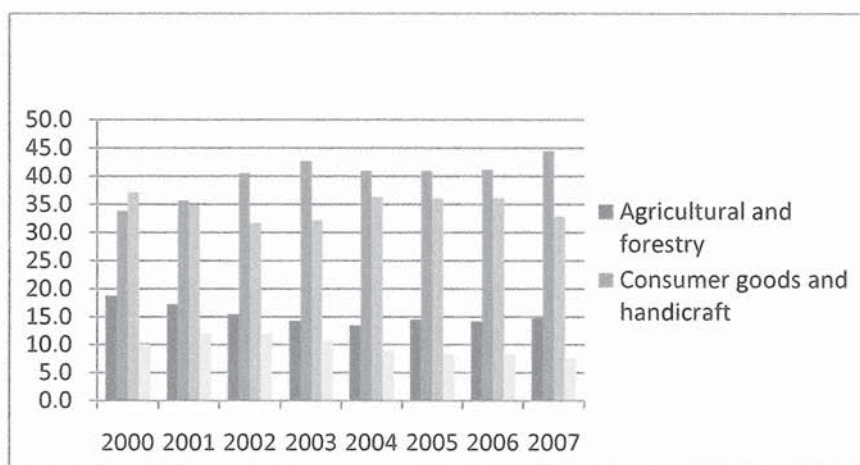
forestry products in the total export slightly increased since 2004. (See Table 5 and Figure 5)

Table 5: Percentage of GDP by sector in 2000 and 2007

Sector	2000	2007
Agriculture	23.3	17.9
Processing	18.8	24.5
Trade	16.3	16.3
Construction	7.5	9.3
Mining	6.7	4.9
Government	4.4	4.1
Transportation	3.9	4.0
Education	3.3	3.4
Utility	2.3	3.1
Financial	2.1	2.1
Others	11.3	10.5
<u>Total</u>	<u>100.0</u>	<u>100.0</u>

Source: GSO, GDP by Economic Sector at Constant 1994 Prices, 2009

FIGURE 5: VIETNAMESE EXPORTS BY PRODUCT, 2000-2007



Source: GSO, Export Revenues by Economic Sector and by Commodity Group, 2009

The movement and spending effects in employment did not occur in the 2000-2007 period. The employment in agriculture declined slightly by 0.6% while that in financial and consulting service increased three times collectively. Employment in other services, such as utility, construction, and trade, also increased significantly. The mining industry experienced an upward trend in employment, an increase of 55%. The spending effect, the shift of employment from the lagging sector to the service sector, is insignificant since only the agricultural sector observed a slight decline while other manufacturing industries experienced growth. As the extractive sector is capital-intensive, this shift in labor from the manufacturing sector to the mining industry seems to be insignificant. Thus, the movement effect is negligible. (See Table 6)

TABLE 6: EMPLOYMENT GROWTH RATE BY SECTORS, 2007 VS. 2000

Sectors	Employment growth rate, 2007/2000
Agricultural	0.94
Seafood	1.65
Mining	1.55
Processing	1.68
Utility	2.38
Construction	2.18
Trade	1.36
Financial	2.79
Consulting	3.38
Government	2.11

Source: GSO, Structure of Employed Population as of Annual 1 July by Ownership and by kind of Economic Activity, 2009

Over the last 15 years, the Vietnam dong (VND) has depreciated against the U.S dollar (USD), except for a slight appreciation prior to 2007 (Sofat, 2008, pg. 3).

Normally, an inflow of the USD into the economy due to strong exportation and FDI should result in an appreciation of the domestic currency. Nonetheless, since 1994, the VND has experienced a slow depreciation. is the dong pegged to the USD under a crawling peg mechanism⁸, which helps Vietnamese exports to be more competitive in international markets. As the export-led growth model remains effective for the Vietnamese economy, a depreciated VND scheme will prevail in the long run. Given a moderate amount of export revenue brought by bauxite mining projects, the inflow of the USD from the exportation of alumina is unlikely to appreciate the domestic currency.

The Dutch disease seems not to be problematic for some developing countries like Vietnam as the country is labor-abundant and the domestic currency likely depreciates rather than appreciates. Even if the VND appreciates against the USD, the manufacturing sectors, which account for a large portion of intermediate good imports, unlikely lose their competitiveness because prices of imported goods are cheaper due to an appreciated domestic currency. The greatest concern, however, lies in the poor management of the government and the instability of the prices of primary commodities, which include oil, bauxite, and coal in the world markets. For example, export revenues from crude-oil in the first quarter of 2009 experienced a sharp decline. As the world oil prices plummeted from \$100 in the last quarter of 2008 to \$45 in the first quarter of 2009, Vietnamese export revenues from crude-oil declined by 29%. Thus, the plunge in crude-oil export revenues adversely affects GDP (Ha, 2009).

⁸ Crawling peg mechanism is a system of exchange rate adjustment in which a currency with a fixed exchange rate is allowed to fluctuate frequently within a small band of rates while in the adjustable peg mechanism a nation announces a fixed parity (peg) for the exchange rate against strong currencies but retains the option to adjust the parity to a new value if there is a sufficiently large change.

Over the next fifteen years, bauxite and alumina products are expected to reduce the high dependence of export revenues on crude oil and diversify Vietnam's exports in primary commodities. Since prices of primary commodities in the world market are volatile; however, the dependence on bauxite and alumina industry can lead to an unstable export revenue and GDP. Thus, the ambition of the Vietnamese government to develop the alumina industry as well as to ensure sustainable development is challenging in the long run.

IV. TOWARD ECONOMICALLY, ENVIRONMENTALLY, SOCIALLY, AND CULTURALLY SUSTAINABLE INVESTMENT

Two important questions to be considered in regard to the goal of sustainable development: Can bauxite resources be the major source of growth for the country and the Central Highlands? When and how should bauxite resources be extracted so that economic development could be maintained in the long run? The decision to preserve or extract natural resources should be evaluated against the country's endogenous capabilities such as technology, human capital, and infrastructure. Besides severe consequences in terms of environmental pollution, social instability, and cultural degradation, the exportation of raw materials or primary goods brings a much smaller profit in comparison to those of intermediate or finished products. For example, the price of aluminium is approximately 6 times higher than for alumina and 60 times higher than for bauxite. Given the projected pace of extracting bauxite, the bauxite reserve in Vietnam can be exhausted after 60-100 years. On a global scale, empirical evidence shows that in the period 1950–2000, the growth rate for bauxite consumption per capita was 4% and that bauxite production growth rate for the same period was 5.6%. If the future annual bauxite production growth rate is 5%, then the currently known reserves of 22 billion metric tons can be exhausted within the next 20 years and the reserve base can be sufficient for 25 years (Meyer, 2004, pg. 168). Thus, Vietnam would gain more economic benefits from its bauxite resources if the extraction is left until the country is technologically and financially capable to develop aluminium.

Recently, China has strengthened its economic relationship with various African countries; its growing presence in Africa has recently captured international attention. Many African countries are major suppliers of natural resources for China: Mozambique (timber), Zambia (copper), Guinea (oil), and Congo (with a variety of resources) (Behar, 2008). Nevertheless, natural resources that are needed to meet the rising demand of rapid economic growth are not China's only interest. Other economic motives are more important. For example, China's trade with Africa increased from \$10 billion to \$20 billion in 2004. In addition, Chinese goods flood African domestic markets and undermine local industries in African countries (Lyman, 2008, para. 13).

As previously discussed, the major trade strategy of the Chinese government is that state owned companies engage in less profitable investments by bidding low on various projects to gain entry into the other country and establish economic ties. The Chinese government's long-term objective is access to abundant natural resources and the license to extract them in the future (Lyman, 2005). Nevertheless, along with the limited local capacity and resources to implement various regulations, porous borders, which facilitate informal movement of goods and people, hamper countries in the Mekong region to take advantage of Chinese investments. In addition, Chinese mineral mining companies usually bring Chinese workers to work in overseas mining projects rather than employ the host country's labor. In the Tan Rai and Nhan Co projects, Chalico currently employs 700 Chinese people to work in Lam Dong and Dak Nong provinces. The current of immigration, as a result, puts pressure on the infrastructure system and intensifies environmental pollution and social disorder problems.

Under the Environmental Protection Law, a strategic environment assessment (SEA) must be conducted before a project comes into operation. This requirement, however, was ignored by Vinacomin, who plays the double role as the SEA planner and project contractor in the Tan Rai and Nhan Co projects. Without a SEA, the cumulative and interregional impacts on the environment, economy, and society were largely ignored. To many experts, the absence of a SEA for bauxite mining projects in the Central Highlands is due to Vietnam's lack of experience in conducting SEAs, the limited government budget for the implementation of regulations, and the urgent need to extract bauxite to meet market demand (Lazarus, 2009, pg. 29).

1. BEST PRACTICES

1.1. AUSTRALIA

On a global scale, there is strong evidence from resource-rich countries, such as Australia or Nigeria, that negative impacts from mining activities could be controlled with the adoption of environment-friendly technologies, advanced management, and the effective cooperation of government, businesses and civil groups. Australia is endowed with the second largest bauxite reserve in the world (7.9 billion tons) and has extracted bauxite since the early 1960s. Two main aluminium manufacturers in Australia are Rio Tinto and the U.S-based Alcoa, the world's leading manufacturer of primary aluminium, aluminium products, and alumina. Currently, Australia accounts for 12% of the world alumina market. Alumina refining and aluminium smelting industries in Australia are well-known for their competitive prices and high environmental protection. In Western Australia, the costs to transport bauxite from mining sites to sea ports are cheaper as most of alumina refineries such as Wagerup are located in coastal areas. Moreover, electricity

prices in Australia are approximately 4-4.5 U.S. cents per KWh, highly cost-effective for alumina refining. A stable and dry climate throughout the entire year, low energy costs, and high efficiency technologies also make alumina produced by Australian mining companies highly competitive in the world market.

In terms of environmental protection, wet deposition of red mud, which is highly hazardous to the environment and human health, is no longer used. Instead, Alcoa has switched to “dry stacking” technology since 1985. Although the cost is thought to be high (150 million Australian dollars), this new red mud management method is greatly valued due to many benefits:

- a higher density deposit which can help to reduce the total volume of stored tailings, which is impossible in wet deposition
- less land is exposed to residue
- risk of groundwater contamination is reduced
- completed areas can be reclaimed and revegetated quickly
- safety hazards to people and wildlife are diminished

Some advanced uses of bauxite residue have been studied. For example, dried residue, which has a high acidic level, can be used as a neutralizing agent for treatment of acid mine drainage and amendment of acid producing soils or as a raw material for producing cement alternatives such as mineral polymers and ceramics.

The role of the Australian government and community groups to investigate and supervise mining activities is crucial. In Australia, good mining practices and sustainable development for mining areas have long been executed. Since the early 1970s, Alcoa has provided free tours for community groups and interested persons to visit the mines and the restored areas. Approximately 8,000 people take these tours every year and to date,

over 500,000 people have visited the mines. These activities are part of Alcoa's commitment to cooperate with the government and community to meet the rehabilitation criteria. The Department of Environment and Conservation (DEC) and Alcoa developed a practical and achievable set of completion criteria for mine sites. Alcoa is required to submit documentation which certifies its compliance with restoration practices to DEC and other governmental land assessment authorities (Gardner and Bell, 2007).

1.2. NIGERIA

Another example of best practices is the Nigerian Delta. In Nigeria, this region is the major source of oil revenues and accounts for approximately 96% of state foreign earnings and 85% of state revenues. Thus, the Delta region is critical to the nation's economic and political survival; however, this region is one of the poorest, least developed, and least returned for its contributions to national wealth. The contradiction of wealth generation and poverty has generated anger, frustration, and hostility directed at the state and multinational oil corporations (MNOCs) (Ikelegbe, 2001).

As a result, one of the greatest challenges in Nigeria pertains to the rights and access of indigenous people to resources generated in their territory. Since the late 1990s, civil groups in the Nigerian Delta have become very active. Various civil groups such as youth groups, pan-ethnic groups, environmental groups, and civil right groups, achieved successes in terms of economic, social, and political equality in oil-based communities. For example, communal and ethnic civil groups represented the interests of the indigenous people and responded on their behalf to the policies and practices of the state and MNOCs. One of the most recognized groups is the Movement for the Survival of the Ogoni People (MOSOP), a civil group of the Ogoni ethnic people. Several environmental

and civil groups such as the Niger Delta Human and Environmental Rescue Organization, Environmental Rights Action, Oil Watch Group, and other international civil groups including the Human Rights Watch, Sierra Club, and Trans Africa, are actively involved in at least three main activities: 1) protest against oil spillages and MNOCs' compensation practices; environmental damage and MNOCs' irresponsibility, 2) the quest to assess and reduce environmental impacts, and 3) the monitoring of environmental degradation and the advocacy of environmental standards and actions on behalf of affected communities (Ikelegbe, 2001). Specific protests are usually undertaken by communal and ethnic civil groups such as the MOSOP and other pan-ethnic and environmental groups. All the groups request compensation or reparation from the MNOCs for the four decades of environmental devastation and the consequent social, economic, agricultural, health, and related disturbances. These groups also seek compensation and reparation for the oil extracted from their land in which appropriate benefits and social responsibility have received very little attention.

2. POLICY IMPLICATIONS

To maximize the benefits from bauxite reserves and minimize their impacts on the socio-economy, environment, and culture of the country in general and the Central Highlands in particular, several policies should be implemented to ensure bauxite mining activities do not hamper economic development.

2.1. PLAN THE EIA

As the environmental impact is the central concern, an independent committee should be established and responsible for the planning of the EIA in regard to the Tan Rai

and Nhan Co projects. This committee should be comprised of individuals from different professions and social groups, who represent the interests of bauxite-based communities and the nation as a whole. The scope of the EIA should not be limited to the impacts on the Central Highland but also the downstream region. The decline of underground and surface water resources, the potential pollution to the downstream region, and the biological degradation, along with solutions to renovate the biological diversity, land use, and revegetation after finishing bauxite mining activities, need to be addressed. The resulting conclusions of the EIA must be open and accessible to the public, especially the indigenous people in the Central Highlands. It is the right of affected people to be well-informed of the potential impacts on their living environments so that they can initiate appropriate responses that help to mitigate negative consequences.

2.2. IMPROVE ENVIRONMENTAL STANDARDS AND REQUIREMENTS FOR CORPORATE SOCIAL RESPONSIBILITY

The Ministry of Natural Resource and Environment can enforce new regulations for environmental standards. These regulations should focus on the mining industry and prevent out-dated and pollution inducing technologies adopted by the Chinese contractor. The application of dry stacking technology which has been successfully used by Australian alumina refineries should also be considered.

Recently, the International Institute for Sustainable Development (IISD) has publicized some reports on the role of Chinese mining companies in the Mekong Delta region (see Lazarus, 2009 and Rutherford et al., 2008), which emphasize that China's own environmental and social policies are becoming more progressive, and that China is expected to play a leading role to shape the industry in a more sustainable manner. As

many Chinese companies open mining operations in other countries, they need to comply with their host countries' laws and regulations. China can become a global leader in environmentally and socially sustainable mining of bauxite if its mining firms comply with global best practices and principles such as the International Council on Mining and Metals Sustainable Development Framework. China should carefully monitor Chinese overseas investments and strengthen its own investment regulations. In addition, China needs to strategically partner with other governments where its companies operate and assist those countries to strengthen their own national regulations and to adopt global best practices. Thus, the Vietnamese government could set higher environmental standards in tandem with calls for support from the Chinese government to enforce the compliance of Chinese alumina manufacturers who operate bauxite mining and alumina refining activities in Vietnam. In addition, investment inflows are not impeded while high environmental and social standards can be met.

2.3. INVEST IN INFRASTRUCTURE AND EDUCATION TO DEVELOP REGIONAL POTENTIALS

Ethnic minority communities which live in remote and isolated regions still face many difficulties and challenges as a result of nomadic life, primitive farming techniques, and low incomes. Difficulties exist with a poor infrastructure system and low levels of education as well as capital investment shortages. Thus, the Vietnamese government should initiate training and human resource development programs, which focus on the old villagers and local officials to promote national unity among ethnic minority groups. More local people should be trained and employed in bauxite mining and alumina refining activities to improve labor skills and income; knowledge and skills gained from

employment can help these workers to be able to engage further in future mining projects.

Infrastructure development policies are important to the long term growth of the region. As the railroads are costly and more importantly, their limited capacity is unable to serve public needs, much consideration should be given to the investment in a road system which connect the remote highland areas with the downstream region. An advanced road traffic system could help to facilitate trade in agriculture and industrial products and promote eco-tourism in which the Central Highlands, endowed with various rain forests and the Gong culture, has a high potential.

2.4. FOSTER THE INVOLVEMENT OF CIVIL GROUPS AND INTERNATIONAL ORGANIZATIONS

In regard to the reimbursement policy, the livelihoods of indigenous people, especially the displaced, are severely affected. As discussed, the reimbursement amount per each affected household and unit of land (i.e. \$ 2,200 per hectare) is inadequate and insufficient for a displaced household to start a new life. Thus, the provision of housing, arable land, and usable infrastructure such as electricity and water needs to be fully included in the reimbursement fund. To preserve cultural traditions of the ethnic minority groups, displaced ethnic people should not be forced to replace their nomadic lives with the living style of collective houses. Moreover, revegetation and biological rehabilitation plans should be drawn to minimize potential impacts of bauxite mining and alumina refining activities so that large-scale pollution can be avoided.

The success of civil groups in Nigeria could be a good example for Vietnam to follow. Indigenous people, in the form of civil groups, can play a critical role to claim

adequate reimbursement and to monitor the impacts of bauxite extraction. For example, civil groups can ask the contractors for adequate land reimbursement and for new neighborhoods with basic conditions such as arable land, hospitals, schools, and transportations to support a new life.

These civil groups can also call upon the corroboration with international organizations in environment protection activities such as the WWF, IISD, Green Peace or The United Nations Environment Program (UNEP) to establish environmental programs in the Central Highlands. Currently, UNEP has launched a major worldwide tree planting campaign. Under the *Plant for the Planet: Billion Tree Campaign*, people, communities, business and industry, civil society organizations and governments are encouraged to enter tree planting pledges online with the objective to plant at least one billion trees worldwide each year. In a call to further individual and collective action, UNEP has set a new goal to plant 7 billion trees by the end of 2009. The campaign strongly encourages the planting of indigenous trees and trees that are appropriate to the local environment (UNEP, 2009). Civil groups in the Central Highland can also initiate a similar program to protect the environment and monitor the bauxite sifting and alumina production activities.

V. CONCLUSION

If the rationale behind bauxite mining is to spur economic growth as well as to ensure sustainable development, the potential impacts on the national economy and the well-being of indigenous people in the Central Highlands have challenged these objectives. First, out-dated technology, poor management in public investment projects, and lack of rigorous environmental assessment requirements can generate a great deal of untreated red mud and tailing slurry, loss of biodiversity, and an increase in social disorders and cultural degradation, which adversely affect the economy, environment, and society of not only the Central Highland but also the Dong Nai river watershed. Second, as world aluminium prices experienced a constant downward trend since the mid-1930s and are highly sensitive to the global economy, the Vietnamese government faces many challenges to maintain stable export revenues from bauxite and alumina. In such an unstable scheme, policymakers are confronted with numerous difficulties to accomplish well-managed, effective, and efficient economic plans. Third, given the small proportion of alumina to crude-oil in export revenue and GDP, the bauxite mining and alumina refining industry unlikely will produce the Dutch disease on the Vietnamese economy. Nevertheless, the “resource curse” hypothesis implies that social disorder, cultural degradation, and loss of biodiversity are unavoidable during the stages of natural resource extraction.

Achieving economic growth objectives in congruence with ensuring the well-being of the present and future generations is not an easy job for any government. From a

policy-making perspective, natural resource extraction should no longer be taken for granted. A quote by the Dalai Lama⁹ best illustrates an appropriate mindset.

Our ancestors viewed the earth as rich and bountiful, which it is. Many people in the past also saw nature as inexhaustibly sustainable, which we know is the case only if we care for it. Today, however, we have access to more information, and it is essential that we re-examine ethically what we have inherited, what we are responsible for, and what we will pass on to coming generations.

Thus, not only the government but also businesses and civil groups formed by highlanders should take collective actions to minimize the negative impacts of bauxite mining activities. Further studies are needed to examine other potentials of the Central Highlands and ways to develop sustainable sources for the regional growth and development.

⁹ The Dalai Lama speaking on various topics, retrieved Nov. 2009, from <http://hhdl.dharmakara.net/hhdlgspeech.html>

VI. APPENDIX

Alumina is extracted from bauxite ores and is used to produce aluminum. To produce one ton of alumina, 2.0 - 2.5 tons of bauxite are required. Alumina is processed into aluminum by electrolysis. About two tons of alumina are required to produce one ton of aluminum. Bauxite is a rock that consists mainly of aluminum hydrate or hydroxide minerals. Bauxite ore in the Central Highlands is gibbsite and open pit.

The production of aluminium is divided into 3 steps: bauxite sifting, alumina refining, and aluminium smelting. Practically, all the world's alumina production is still produced by the Bayer process and its variation. In particular, the reduction of alumina from bauxite is divided into 4 steps: digestion, filtration and settling, precipitation, and calcinations.

Primary aluminum accounts for about 80% of total aluminum consumption. Aluminum is mainly used to produce consumer goods (making sheets, plates, foils, extruded shapes

and tubes), and in automotive, airplane and electrical industries, or is made into finished products such as residential siding, cooking utensils, aluminum cans, fasteners and closures.

Bayer technology in processing bauxite

1. Digestion: Bauxite is dissolved with caustic soda, under high pressure and heat, to form sodium aluminate.

2. Filtration and Settling (Clarification): Iron oxides and other solid impurities are dropped to the bottom of the settling tanks, as red mud, which is then pumped to a disposal pond.

3. Precipitation: The liquid sodium aluminate is agitated and seeded with aluminum hydroxide crystals in order to form larger crystals, which gradually settle out of the solution.

4. Calcination: The aluminum hydroxide crystals are roasted at more than 1000°C to remove the water.

Source: Hashimoto Hideo (1982)

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